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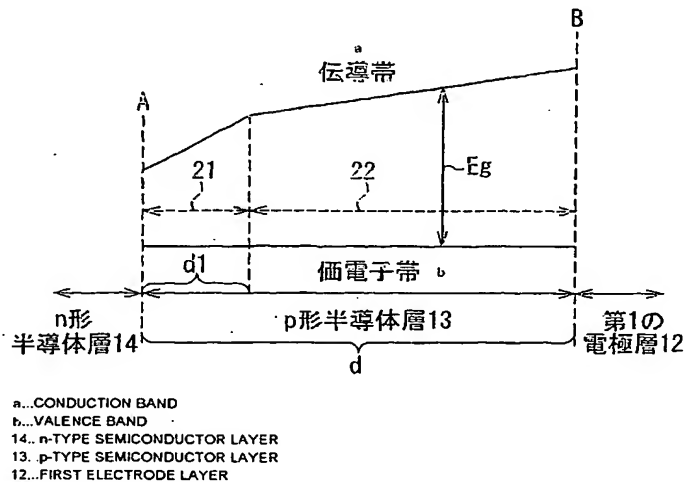
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- (51) 国際特許分類⁷: H01L 31/072, 31/032 (72) 発明者; および
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(22) 国際出願日: 2004 年 4 月 9 日 (09.04.2004) (74) 代理人: 特許業務法人池内・佐藤アンドパートナーズ (IKEUCHI SATO & PARTNER PATENT ATTORNEYS); 〒5306026 大阪府大阪市北区天満橋1丁目8番30号OAPタワー26階 Osaka (JP).
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(54) Title: SOLAR CELL

(54) 発明の名称: 太陽電池



(57) Abstract: A solar cell comprising a light-absorption layer of a compound semiconductor with a chalcopyrite crystal structure and having excellent characteristics such as the conversion efficient. The solar cell comprises a first electrode layer, a second electrode layer, a p-type semiconductor layer interposed between the first and second electrode layers, and an n-type semiconductor layer interposed between the p-type semiconductor layer and the second electrode layer. The p-type semiconductor layer comprises a semiconductor containing a group Ib element, a group IIIb element, and a group VI element and having a chalcopyrite structure. The bandgap of the p-type semiconductor layer increases from the n-type semiconductor layer side toward the first electrode layer side monotonously. The bandgap of the p-type semiconductor layer at the major surface on the n-type semiconductor layer side is above 1.08 eV, and that at the major surface on the first electrode layer side is above 1.17 eV. In the p-type semiconductor layer, the bandgap increase rate in the direction of the thickness of the p-type semiconductor layer in a first region on the n-type semiconductor layer side is different from that in a second region on the first electrode layer side.

(57) 要約: カルコパイライト結晶構造を有する化合物半導体を光吸収層に用いた太陽電池において、変換効率などの特性が高い太陽電池を提供する。第1の電極層と、第2の電極層と、第1の電極層と第2の電極層との間に配置されたp形半導体層と、p形半導体層と第2の電極層との間に配置されたn形半導体層とを含み、p形半導

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NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SI, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

NI, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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— 国際調査報告書

- (84) 指定国 (表示のない限り、全ての種類の広域保護が可能): ARIPO (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), ユーラシア (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), ヨーロッパ (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC,

2文字コード及び他の略語については、定期発行される各PC7ガゼットの巻頭に掲載されている「コードと略語のガイダンスノート」を参照。

体層は、I b族元素とIII b族元素とVI b族元素とを含み、かつ、カルコパイライト構造を有する化合物半導体からなり、p形半導体層のバンドギャップは、n形半導体層側から第1の電極層側に向かって減少することなく増加しており、n形半導体層側の主面におけるp形半導体層のバンドギャップが1.08 eV以上であり、第1の電極層側の主面におけるp形半導体層のバンドギャップが1.17 eV以上であり、p形半導体層において、n形半導体層側の第1の領域と第1の電極層側の第2の領域との間で、p形半導体層の膜厚方向のバンドギャップ増加率が異なる太陽電池とする。

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2004/005125

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl⁷ H01L31/072, H01L31/032

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl⁷ H01L31/00-31/078

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Toroku Jitsuyo Shinan Koho 1994-2004
Kokai Jitsuyo Shinan Koho 1971-2004 Jitsuyo Shinan Toroku Koho 1996-2004

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	M. Contreras et al., "High Efficiency Cu(In, Ga) Se ₂ -Based Solar Cells: Processing of Novel Absorber Structures", First WCPEC (World Conference on Photovoltaic Energy Conversion); December, 5-9, 1994, Hawaii, pp.68 to 75	1-13
Y	K. KUSHIYA et al., "Development of Polycrystalline CuIn _x Ga _{1-x} Se ₂ Thin-Film Solar Cells with Band Gap of 1.3 to 1.5 eV", Japanese Journal of Applied Physics, Part 1, No.12A, Vol.33, (1994). pages 6599 to 6604	1-13
Y	T. NEGAMI et al., "Production technology for CIGS thin film solar cells", Thin Solid Films, 403-404(2002), pages 197 to 203	1-13

☒ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search
21 June, 2004 (21.06.04)

Date of mailing of the international search report
06 July, 2004 (06.07.04)

Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2004/005125

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	T. Dullweber et al., "Study of the effect of gallium grading in Cu(In, Ga)Se ₂ ", Thin Solid Films, 361-362(2000), pages 478 to 481	1-13
Y	JP 9-213977 A (Matsushita Electric Industrial Co., Ltd.), 15 August, 1997 (15.08.97), (Family: none)	1-13
Y	JP 11-274526 A (Yazaki Corp.), 08 October, 1999 (08.10.99), (Family: none)	1-13
Y	A. Dhingra et al., "Computer Simulation and Modeling of Graded Bandgap CuInSe ₂ /CdS Based Solar Cells", IEEE Transactions on Electron Devices, Vol.43, No.4, 1996, pages 613 to 621	1-13